

USING WEATHER RECORDS.¹

By J. CECIL ALTER, Meteorologist.

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The daily temperature and precipitation records at the four or five thousand cooperative weather stations in the United States, and the continuous, automatic records for all the principal meteorological elements at the 200 regular Weather Bureau stations, form a great potential asset, available free to the public. The weather forecasts are read and utilized daily and universally as is no other information, and the value of this intelligence is incalculable. But there is often an equal value, and in many circumstances a far greater value, to be found in the records of what the weather has been.

The weather is a liability only when one attempts to ignore it or to rely on an erroneous belief or a vague weather lore. But it is an asset of inestimable worth when the facts of record are properly applied to business and personal problems. A long weather record, like money, is of no active value unless used. The Weather Bureau aims to maintain weather stations where the product will be of greatest use, and it aims to observe such elements and to record and publish the data in such a manner as to meet the most general need. It is a fact, however, that in establishing the climatic facts of the country as required by law, the bureau has necessarily produced weather records of great value for other purposes far in excess of their general utilization. Consequently a frozen asset of large proportions and of much promise has already been accumulated.

Business enterprises, like the people themselves, live, move, and have their being in the weather to a far greater extent than is commonly supposed. There are in fact comparatively few occupations or businesses that can not be conducted with a little more refinement and certainty, a little less trouble and mistake making, and with an important saving or actual earning of money, by a more frequent use of weather records.

The risk assumed of a killing frost, stormy weather, hail, drought, high wind, or lightning, is a legitimate charge against many businesses; and insurance companies are doing a profitable and worthy business writing weather insurance, basing the premium rates on the weather records. Business men and organizations themselves very often reduce their weather risks by altering their plans or dates to fit better into the weather averages.

A Utah umbrella dealer, who is credited with having made the dollar famous locally, had always ordered deliveries in bulk during the autumn; but on seeing a diagram of normal precipitation by months, ordered deliveries thereafter on the first of each month proportional to the number of inches of normal precipitation. Having a 30-day arrangement for remittances, he has since usually transacted business on the manufacturer's capital, has had a better opportunity to store his surplus stock and to follow styles, and has filled in the dry summer months with parasols. Through a period of years the climate can usually be foreseen in a general way if the specific weather can not. The umbrella season is no better defined in the country's weather records than are the fur clothing, house painting, or countless other seasons.

A Utah sheep breeder was ready to send a flock of rams to the range herds, but, having previously suffered losses at lambing time, inquired for weather conditions on his

range 144 days from the date of the arrival of the rams. The weather could not be predicted that far in advance; but curves showing mean daily minimum temperatures and latest spring killing frosts indicated a period of relative safety beginning shortly after May 20. His previous losses had occurred when the lambs were dated prior to May 15, as had been warranted on another range. Since that inquiry, two successful seasons have followed in those herds, the lambs being brought in late May or early June, as suggested by the weather records.

A new and promising commercial enterprise is rising on Great Salt Lake, largely, through the reassurance contained in a weather record. Sodium sulphate is surrendered in large quantities when the water temperature is below 32°. A group of chemists and capitalists, having the occurrence under observation, noted specific dates and periods when the sulphate cast up on a certain beach could have been gathered profitably before it was redissolved by wave action. A 20-year weather record at Saltair Beach pavilion supplied the answer to the all-important question: How long do such conditions obtain and how frequently do they occur?

Assured of an average producing season of about two months each winter, a \$25,000 harvesting, desiccating, and refining plant was established last autumn and much additional equipment is being installed this season. The company is prepared, however, as admonished by the weather records, to remain idle in an occasional winter and to care for a three or four months' crop in others.

The weather records often serve as detectives, of an impersonal and unimpeachable sort. A smelting company, purchasing coke from a producer 150 miles distant, observed a persistent shortage and after several years filed a claim with the railroad for about \$11,000. The railroad company had reason to believe no coke was lost en route, and a graph of the losses by months showed a striking relationship with weather conditions; that is, the loss was almost nothing from October to March, the season of most numerous storms and highest humidity, some winter shipments having showed a gain, while during the remaining months, or the dry season, of increased winds, the loss ranged from 2,000 to 3,000 pounds per car. Further inquiry developed the fact that the coke was quenched with a heavy spray of water while passing from the ovens to the cars, in which it was weighed. Plainly it was a loss of moisture and not of coke, and the problem resolved itself into an adjustment of weights instead of a claim for losses, the coke company becoming the defendant.

A specializing nut-tree grower, seeking a habitat for pecans in Utah, has applied mean monthly temperatures very successfully to the problem in a scheme or diagram of so-called "pecan units." From an extensive examination and analysis of temperatures, frost, and precipitation in sections where pecans are grown successfully, it was determined that the total number of degrees of mean monthly temperature in excess of 50° formed a basis for rather accurately allocating pecan trees of different varieties; that is, the northern pecan flourishes on a commercial scale in a climate having a total of from 135 to 145 "pecan heat growing units," or mean temperature degrees in excess of 50 for each growing month. The southern pecan requires about 175 pecan units, while the

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primitive southern pecan from which other varieties were propagated requires about 220 units. The inescapable conclusion was that certain Utah sections will grow pecans profitably, and an important acreage is accordingly being planted.

About 50 families of emigrants, having a common language and social experience, moved into what was supposed to be a dry farming section without properly considering the weather records. That district became prominent during the next few years, when the emigrants failed to get crops for want of rain and were forced to move at a great loss.

The colonization agent for a large religious organization was offered an irrigation project, supposedly worth \$100,000 at basic land prices, for the sum of \$18,000, which the company had already invested in improvements. The company expected to make the project worth a million dollars, but failed to finance it for a very good reason. The weather records, which they had overlooked, contained the answer, and the colonization agent turned the offer down. The summers are so short and the nights so cool as to threaten even barley and flax as regular crops.

A farmer with a weather slant owns a hill of moulding sand, which he loads onto freight cars at convenient times and sells to certain Utah foundries. A purchaser docked him 50 per cent on a car received during a prolonged spell of wet weather; but the farmer produced the official weather record and calculated the exact weight of moisture added by the precipitation and saved himself something near \$50.

A consignment of Utah wool reached destination damaged by moisture to the extent of \$7,000. The railroad company was asked to settle, but resisted the claim because there had been no rain at any transfer point and the car roofs were good. A number of substation weather records showed heavy rains in the district about the isolated shearing corral during the time the wool awaited transportation to the railroad.

The same company did not hesitate, however, to pay \$80 for a trunk of clothing that got wet in an official rainstorm at the railroad station whence a college girl departed on a vacation. Neither did it demur at canceling a demurrage charge on a string of empties set on a siding in a Utah grain section during rainy weather. The farmers could not deliver the grain because of muddy roads, a condition beyond their control.

Speaking of muddy roads, a motorcyclist collided with a work team and farm wagon in broad daylight on an unpaved Utah roadway. He very narrowly escaped the final summons, and repined in the State mental hospital for some months because of an aberration resulting from the accident. But he subsequently knew enough to enter the courts armed with weather records to prove that heavy rains prior to the collision had muddied the road, which became deeply rutted, preventing his turning aside for the team. Being in the right-hand path it was decided that he had a legal right to expect the teamster to yield. The teamster's memory was that the road was smooth.

A sheep man of many parts in his own business once pulled the wool over his own eyes by assuming he had discovered that a rainy summer in the Rocky Mountains, which produced much grass and many fat sheep, was also a summer of comparative drought in the corn States, resulting in low yields and high corn prices. He also reasoned that a dry season in the mountains would be a fine time to pick up feeder stock to be

finished on an abundance of low-priced corn. After a couple of expensive surprises he visited the Weather Bureau office and learned, what any meteorologist could have told him before he bought the feeder stock, that such weather relationships were purely accidental.

A mining company developed a goodly stream of water in its underground workings, and, simultaneously a mountain stream near by, used for irrigation, failed appreciably. The miners sought to retain ownership to the water and to establish the fact that dry weather had caused the irrigation stream to dwindle.

One of the most extensive, expensive, and bitterly contested series of water lawsuits in Utah finally grew out of this and another similar case; even distant hydro-electric companies, the Salt Lake City corporation, the State of Utah, and the United States Government taking a so-called friendly hand because of the dangerous precedent that might be established in a decision. The controversy, not yet settled, revolves to a large extent around precipitation records. Was the tunnel flow developed at the expense of the natural stream discharge or are these phenomena masked by a fluctuating precipitation?

In comparatively recent months we have been requested to determine the average and extreme weights of snow per unit area on the roof of a proposed amusement hall down State, a marble kiosk or covering for a statuette, and a warehouse and salesroom in Salt Lake City, as well as six or seven cottages and a club house at mountain summer resorts, where heavy snow is usual. In every case the architect's plans were either drawn with the snow weight figures at hand or the plans were altered subsequently to provide for the calculated maximum strain.

Snow sags heavily when allowed to accumulate, as a railroad company discovered when a band of sheep, being moved to spring pastures, were weighed in with about 4 inches of snow on their backs, and the loss of weight had to be accounted for at destination. Utah lumbermen purchase Oregon spruce and fir, and they sometimes pay freight on Oregon snow and Oregon moisture in the materials, which moisture they are deprived of en route by the dry climates of Idaho and Utah. But the sorest man, perhaps, is the speed fiend in court who blames snow on the wind shield for a collision and is confronted with a weather record establishing an alibi for the storm.

The wind, which accomodatingly comes in at the kitchen window on a summer morning and into the library or across the front porch on a summer evening, when the residence architect has given due consideration to orientation factors in certain locations, becomes a veritable demon when it topples a brick wall or a bill board onto a pedestrian. And, demon though it is, it is designated an "act of God" in law if the wind was hanging up a record run. This circumstance opens the way to a fertile field of excuses; but one wall, well known in our office, could not withstand a trumpet blast. It went up in the afternoon and down at night; and in the lack of a justifiable windstorm, cross-examiners developed some embarrassing facts about the manner of the wall's construction.

The automobile is a modern machine for making wind, as is well known from the joys of ownership to nearly everyone but weather men. But the weather men, who figuratively ride the wings of the wind all day and then walk home at night, have sometimes earned automobiles

for others. A certain new limousine in the hands of an equally new driver overturned on the highway, and the insurance company was asked to exchange the purchase price for the wreck because of a high wind.

The Weather Bureau gained a friend in the insurance adjuster and a new acquaintance in the automobile owner by showing that the highest wind record in the State would have exerted but one-half the pressure against the side of the car that it was admitted to have carried on its tires.

THE WEATHER OF 1923.

By ALFRED J. HENRY.

Precipitation.—Continental United States as a single geographic unit received slightly more than the average precipitation, area alone considered. See the chart of annual deviation from the normal. The districts having a pronounced deficit are the Pacific Coast States, including Idaho, the Lake region and Atlantic Coast States, including the Florida Peninsula. More than the normal precipitation was recorded in the great grazing areas of the West, including the Plains States; also in the Gulf States, Tennessee, and the Ohio Valley. Numerical values of the monthly and annual deviation are given in Table No. 1. Computing the mean deviation for the

To enumerate or even indicate the avenues into which the records in the custody of the Weather Bureau may flow continually or occasionally would be as great a task as to list the places visited by the wind, or shone upon by the sun, or wet by summer showers, or draped by winter snows. It should suffice merely to indicate that this impersonal and impartial arm of the Government is always ready, and usually competent, to lift some individual or business over a hard place and to steady the scales of justice within and outside of the public courts.

United States as a whole the result comes out a negative quantity—2.2 inches. This is explained as due to the magnitude of the deviation in two small districts—Florida Peninsula on the Atlantic (−17.8 inches) and the Middle Pacific coast (13.6 inches).

The outstanding feature of the year as regards precipitation is the heavy rains in the Arkansas Valley in southeastern Kansas in June and in Oklahoma and adjoining States in September and October. Destructive floods occurred in both southeastern Kansas and in Oklahoma.

TABLE 1.—*Precipitation departures, 1923.*

Sections.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Accumulated departure.
New England.....	+2.1	−1.8	−0.5	+1.4	−1.9	−0.4	−0.6	−2.0	−1.2	+0.3	−0.1	+0.7	−4.0
Middle Atlantic States.....	+0.6	−0.8	+0.3	+0.1	−1.5	−1.3	−0.2	−1.6	+0.4	−0.7	−0.8	−0.1	−5.4
South Atlantic States.....	−0.9	−1.2	−0.6	−0.8	+0.8	−1.9	+0.4	−0.9	−1.0	−1.8	−0.9	−0.4	−9.2
Florida Peninsula.....	−2.2	−2.3	−1.6	−0.6	+3.4	−1.7	−2.1	−1.7	−2.0	−3.6	−1.8	−1.6	−17.8
East Gulf States.....	−1.5	+0.8	+0.2	+1.9	+5.1	+0.9	+0.6	+0.8	−2.4	+0.5	+0.8	+0.4	+8.1
West Gulf States.....	+0.5	+1.4	+0.2	+0.9	−0.3	−1.1	−0.1	−0.7	+2.1	+0.4	0.0	+3.0	+6.3
Ohio Valley and Tennessee.....	+0.9	−0.2	+0.1	+0.4	+0.2	+0.4	−0.2	+1.0	−0.1	−1.0	−0.6	+2.4	+3.3
Lower Lake region.....	+0.1	−1.0	−0.3	−0.3	−0.1	−0.7	−1.4	−0.8	0.0	−0.7	−0.5	+0.8	−4.9
Upper Lake region.....	−0.4	−0.6	+0.4	−0.6	−1.0	−0.8	+0.3	−0.3	+0.1	−0.2	−1.4	−0.2	−4.7
North Dakota.....	−0.2	0.0	−0.5	−0.2	−1.2	+0.3	−0.3	−0.6	+0.7	−0.4	−0.3	−0.3	−3.0
Upper Mississippi Valley.....	−0.2	−0.9	+1.2	−0.8	−1.1	−0.3	−1.9	+0.8	+0.9	−0.4	−0.3	+0.1	−3.4
Missouri Valley.....	−0.2	−0.7	+0.2	−0.4	−1.0	+1.2	−1.0	+0.7	+2.2	+0.4	−0.3	−0.1	+1.0
Northern slope.....	−0.3	−0.3	−0.3	0.0	+0.1	+0.8	+0.9	+0.5	+1.1	+0.9	−0.3	−0.2	+2.9
Middle slope.....	−0.2	−0.4	0.0	−0.2	+0.9	+2.3	−0.6	+0.4	+1.6	+3.0	0.0	0.0	+6.8
Southern slope.....	+0.4	+1.1	+1.0	+1.2	−2.0	+1.5	−0.7	−1.3	+1.4	+3.8	+1.2	+0.6	+8.2
Southern Plateau.....	−0.5	−0.2	+0.1	+0.1	−0.1	−0.3	−0.5	0.0	0.0	+0.1	+0.4	+0.4	−0.5
Middle Plateau.....	+0.2	−0.7	−0.4	+0.2	−0.4	+0.4	−0.1	+0.5	+0.2	−0.1	−0.2	−0.4	−0.8
Northern Plateau.....	−0.1	−0.5	−0.9	+0.1	−0.4	+1.2	+0.3	+0.4	−0.4	+1.0	−0.5	−0.2	0.0
North Pacific coast region.....	+2.3	−1.8	−2.1	−1.2	−0.7	−1.1	+0.5	+0.4	−1.0	−1.4	−3.7	0.0	−9.8
Middle Pacific coast region.....	−2.0	−3.3	−3.7	+0.7	−0.9	+0.3	0.0	0.0	+0.7	−0.6	−2.7	−2.7	−13.6
South Pacific coast region.....	−0.6	−1.4	−2.4	+1.8	−0.6	0.0	0.0	0.0	+0.2	−0.6	−1.1	−1.3	−5.8
United States as a whole.....													−2.2

Temperature.—For the country as a whole the year was a warm one, thus completing a period of three consecutive warm years, in two of which the warm weather was more pronounced than in the year just closed. The latter was not characterized by periods of unduly warm or cold weather respectively, although January was uniformly warm for a winter month in all parts of the country. June was a rather warm summer month, being characterized, in the East, by a rather large number of consecutive days with high day temperature, but the two summer months immediately following were, on the whole, agreeable months, the periods of high and low temperature alternating in such a manner as to prevent long continued spells of high day temperatures.

August was unusual in respect of movement of marked anticyclones into the Missouri Valley from the Canadian Northwest and these were naturally associated with abnormally cool weather for the season.

In some quarters such a movement is held to be indicative of the early approach of cool weather; in this case, however, the promise failed to materialize, the months of November and December being unusually warm. The numerical values of the variations from normal by districts are given in Table 2 and geographically by the chart on the reverse side of the precipitation chart.